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The Chief of the Patent Office certifies that Dr. AMR ALI MOKHTAR AL-HOSSARY  
( Address : EL MORSY STREET - ARD ALETR - AL- SANANEYYAH - DOMIETTA - EGYPT )  
has filed application No. 2003111025 on 11/11/2003 to obtain a patent for an invention titled :

“ ELIMINATION OF MYOGLOBIN FROM BLOOD USING AN IV FILTER “

The inventor of this application is Dr. AMR ALI MOKHTAR AL-HOSSARY

This Document has been given to Dr. AMR ALI MOKHTAR AL-HOSSARY upon his request dated  
30/01/2005

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This is the translation of the application No. 1025/2003 filed on 11/11/2004

## The full description of the invention

### The previous art:

The term of **Myoglobinemia** stands for the existence of myoglobin in the blood, that is, oxygen bearing protein-weighing 18800 Delton originally found in the Sarcoplasma of rhabdomyocyte. That occurs in some conditions; yet, we focus here on the acute traumatic cases resulting from crushing the striated muscles, e.g. crush syndrome, or the falling ruins of the disasters.

**Rhabdomyolysis** means the decomposition of striated muscles causing the release of the rhabdomyocyte contents into the interstitial fluid. The Myoglobin is one of the basic contents that is released in the blood. It is an oxygen-carrier molecule similar to great extent to hemoglobin; however, it does not contain but a single [Heam-] moiety.

The other components released are calcium, phosphorus, potassium, and nucleosides.

### The substantial causes of Rhabdomyolysis:

\* The trauma and compression in the cases of accidents, crush syndrome, earthquake, wars, and also in the cases of taking strict sole position for long time (e.g. as in some therapeutic interventions requiring long time-staying in a specific position, and some orthopedic problems.

\* Occlusion of muscular vessels as in the thrombosis, occlusion, or clamping.

\* Drugs and toxics as alcohols and heroin



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**The pathology of Rhabdomyolysis:**

Rhabdomyolysis occurs via three impacts:

**Disturbance of cell metabolism**

Such disturbance causes the access of calcium into the cell resulting in persistent contraction, cell death, and generation of free radicals. Also the cell is to be overwhelmed by leukocytes of activated neutrophils chromatoid producing protons, and free radicals.

**Reperfusion injuries:**

Most of damages caused by the ischemia follow the restoration of blood re-flow; just then, the leukocytes migrate toward the injured area. Only after reperfusion of oxygen, free radicals are generated.

**Compartment syndrome**

If the energy-transcellular sodium pump fails as a direct result of ischemia, the rhabdomyocyte swells, thus, increasing the inter-compartmental pressure (the increase of pressure up to [30 mm. mercury] drives to ischemia of clinic significance, however, in hypotensive patients, even lower compartmental pressure will cause reperfusion problems.

**Metabolic derangement during Rhabdomyolysis**

The release of decomposed striated cell into the blood leads to the concentration change of several plasma components, and if acute renal failure occurs, the state gets worse.

Myoglobin: (that is to be combated) is released and driven into the venous circulation.

The fluids: large mounts of fluids accumulate in the injured limbs (up to 10 liters per limb). The condition of not compensating this missing mount may cause a shock, hypernatremia, and deterioration of renal functions.

Large mount of potassium is also released that the kidney cannot remove if acute renal failure develops.

Calcium and phosphorus are released and may be precipitated in tissues.

Nucleosides are released from the rhabdocyte nuclei into the blood to be metabolized in the liver and transformed into Xanthine, Hypoxanthine, and Uric acid.



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The release of organic acids, as well as, uric acid (resulted from the metabolism of nucleosides) causes high anion gap

### The pathophysiology of acute renal failure:

Myoglobin is easily filtrated across the renal glomerular basement membrane toward the tubules. Water is absorbed out of tubules to the blood to be recycled continuously; thus, the rate of myoglobin rises proportionally in the tubules that, in turn, get blocked via the precipitation of the myoglobin casts.

The fall of [pH] - the acidosis- assists the precipitation of both myoglobin and uric acid, and, the middle fraction of Heame- works on the fats oxidation and renal injury.

Moreover, the myoglobinolysis in the tubules drives the release of free iron radicals that, in turn, catalyzes the release of free oxygen radicals encouraging the occurrence of ischemic damage. 20-50 % of these cases cannot survive it.

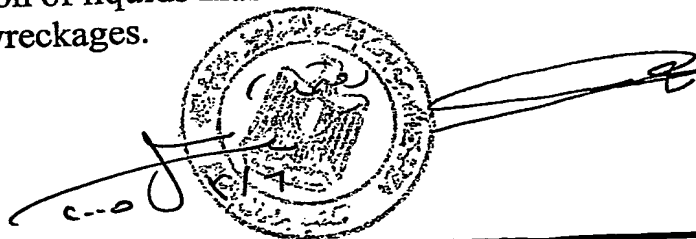
### The prevention and therapy:

The main target is to curb the causes of occurring acute renal failure as hypovolemia, accidents, tubular obstruction, and the generation of free oxygen radicals.

That attempts to be accomplished via:

- Opening an intravenous line (before the patient is being extricated).
- Giving liquids, Mannitol, Sodium bicarbonate, and the likes via the installed intravenous line.

Liquids: adding up to 10 liter per limb end averting the occurrence of hypovolemia. In such cases that muscle compression is the outcome of trauma, the insertion of liquids must commence even before the patient is extricated out of wreckages.



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Sodium bicarbonate: is effective in the equilibration of acidosis, thus, preventing the precipitation of myoglobin in the kidney tubules, as well as, minimizing the risk of increasing hyperkalemia.

Mannitol: is used for the purpose of

- Increasing renal blood flow, and glomerular filtration.
- Being an osmotic agent attracting fluids from interstitial compartment so as to balance hypovolemia, and lessen the muscle swelling, the nerve compression.
- Being diuretic increasing the urine flow and preventing the formation of casts.
- Scavenging the free radicals.

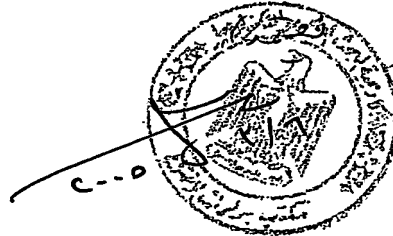
**Extracorporeal blood purification:**

In case of occurring acute renal failure or an extreme increase of hyperkalemia and acidosis, the patient needs diaysis.

Heamodialysis is resorted as the only hope for maintaining the patient survival, where peritoneal dialysis cannot be one of possible options.

Plasma exchange is of no use owing to the high rate of myoglobin disappearance.

It is prescribed to do venotomy during reperfusion surgeries, for example, the surgery of embolectomy in the cases of ischemia for the purpose of discharging the initial 500 ml of intravenous blood re-flowing to the circulation after removing the artery blockage, in an attempt to purifying the blood from harmful components.



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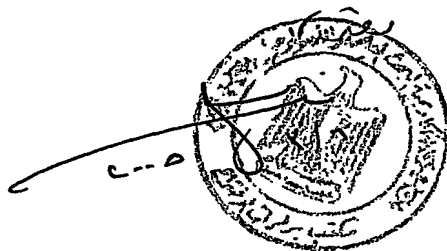
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**The problems or deficiency of previous art:**

The idea of losing 500 ml of the blood is unacceptable. It can be tolerated in equipped operation rooms but unlikely in emergency cases, more specifically, in cases of an already-bleeding person developing into severe hypovolemia.

Peritoneal dialysis is inapplicable for abdominal injuries. Generally, the techniques of extracorporeal blood purification are supportive treatment aiming at overcoming the stage of acute renal failure disregarding the need of treating the cause of the problem. They also necessitate whether conveying the injured to the nearest treating center or transforming integrative dialysis unit into the disaster scene. Such techniques also require administering anti-clotting substances to the patients. (Notice that we refer to an already injured and bleeding patients)

There has no fall in the death rate during the past 20 years even with the application of dialysis. That, in turn, prioritizes the necessity of providing prevention against acute renal failure.



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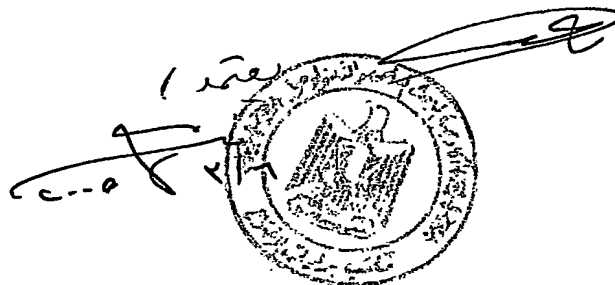


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**The new in the invention:**

- The target is to trap myoglobin whilst its flow in the venous blood before reaching the heart to be pumped all over the human body using the invented attracting filter.
- This approach is directed toward the main cause of the problem not merely for overcoming a stage of bad consequences.
- The filter is to be pulled out immediately, prior to the occurrence of anaphylaxis causing death.
- It even will be caused with myoglobin all around, that is, a natural component of the blood, consequently, not leading to anaphylactic shock upon leaving it for a longer period in the body, considering the liability of rescuing the increasing numbers of the injured people in the disasters.
- This filter is likely easy to be installed in the same way of introducing a cannula.

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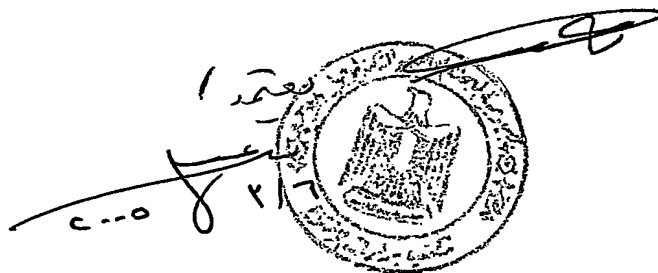
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**The detailed description:**

Myoglobin is to be trapped via inserting myoglobin filter into the vein working on draining the injured area or limb (e.g. femoral vein in case of lower limb). Preferentially, it is inserted into [I.J.V] in such way similar to that of inserting the IVC filter providing the needed protection against embolisation in cases of deep veins thrombosis [D.V.T].

The relevant filter is a rod comprising of central axis of any convenient wire sheathed with Latex coated with antimyoglobin antibodies. The filter is percutaneously placed across cannula. It is inserted as in opening intravenous line before raising the patient off the wreckages. This filter functions upon inserting it in the blood. If the filter with its entire length misses any particles of myoglobin and reaches the heart, it is to be trapped in the following circulation. (Notice that the filter is present in jugular vein, superior vena. cava, inferior vena. cava, and even the right atrium). It keeps working till it gets thoroughly saturated with the myoglobin particles, just then it can be pulled out, or when there is no peril.

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محرور حوكم



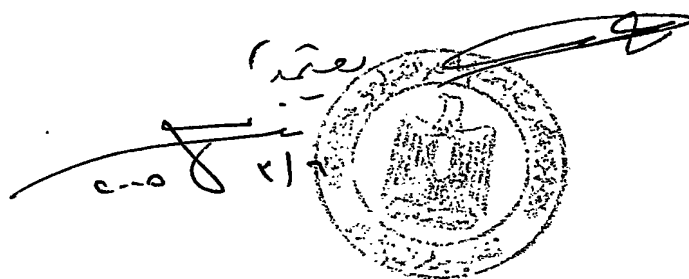


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**The exploitation method:**

Such implement is oriented to all states of Rhabdomyolysis specifically for in-situ prevention in cases of disasters, crush injuries, and reperfusion injuries in limbs.



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**Figures**

- (1) Wire
- (2) A Latex mareial
- (3) Antimyoglobin antibodies
- (4) A cannula



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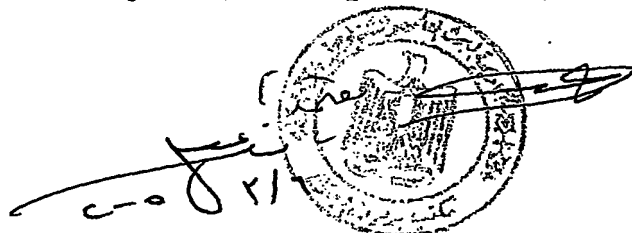
(12) Patent

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Blood purification out of myoglobin using an IV filter

(57)

The related invention revolves around the idea of preventing the occurrence of Acute Renal Failure following Myoglobinemia in cases of Rhabdomyolysis. By means of trapping myoglobin released to circulation following striated muscles injury using a temporary intravenous filter, hence prophylaxis of Acute Renal Failure, which commonly follows this situation. It is directed to all cases of Rhabdomyolysis especially for "In situ prevention" in cases of disasters, crush injuries, and reperfusion injury in a limb.



إنياس ابراهيم  
مدير مكتب

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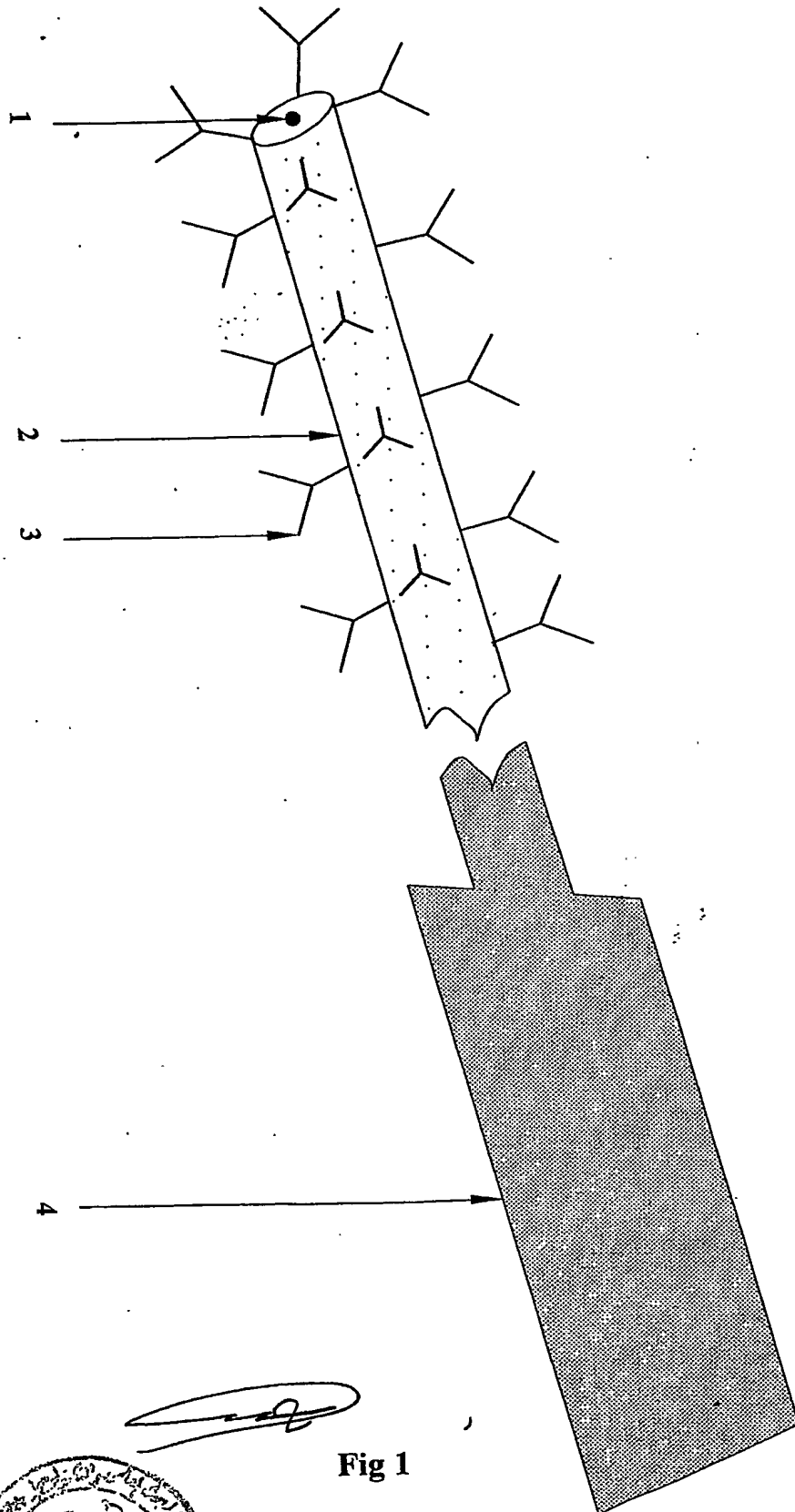
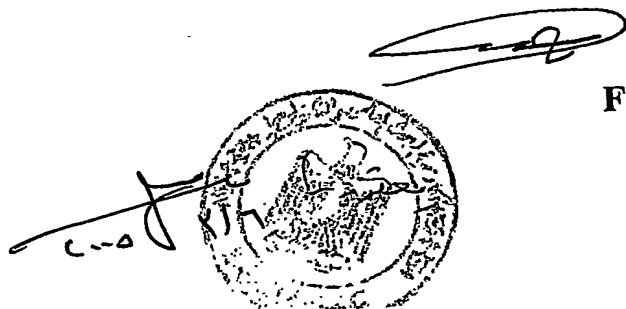


Fig 1



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